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APPRENTICESHIP TRAINING

Sheet Metal Worker Program

Alberta
LEARNING
Apprenticeship and Industry Training

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Sheet Metal Worker

Table Of Contents

Apprenticeship and Industry Training System 2
Apprenticeship and Industry Training Committee Structure 2
Local Apprenticeship Committees (Lac) 2
Provincial Apprenticeship Committees (Pac) 3
The Alberta Apprenticeship and Industry Training Board (Board) 3
Safety Education 3
Legal and Administrative Aspects of Safety 4
Technical Training Establishment 4
Procedures for Recommending Revisions to the Course Outline 5
Apprenticeship Route Toward Certification 6
Sheet Metal Worker Training Profile 7

Course Outline

First Period Technical Training 9
Second Period Technical Training 19
Third Period Technical Training 25
Fourth Period Technical Training 32

Apprenticeship and Industry Training System

Apprenticeship is post-secondary education with a difference. It helps ensure Alberta has a steady supply of highly-skilled employees, the foundation of our economy's future health and competitiveness.

Apprentices in more than 50 trades and crafts spend between one and four years learning their trade - 80% of the time on the job under the supervision of a certified journeyman or qualified tradesperson. The balance of the program is technical training in the theory, skills and technologies of their trade.

To become certified journeymen, apprentices must learn theory and skills, and pass examinations. Requirements for certification—including the content and delivery of technical training—are developed and updated by the Alberta Apprenticeship and Industry Training Board (the Board) and a network of local and provincial industry committees.

The graduate of the Sheet Metal Worker apprenticeship training is a journeyman who will be able:

- supervise, train and coach apprentices.
- use and maintain hand and power tools to the standards of competency and safety required in the trade.
- apply the correct principles of sheet metal pattern development using triangulation, parallel line, and radial line development.
- read and use blueprints and specifications to estimate, fabricate and install sheet metal items.
- fabricate and install, safely and efficiently, fume and dust exhaust systems, ventilation, heating and air-conditioning systems and equipment for restaurants, hospitals, dairies, breweries, etc.
- know, and be able to apply their knowledge of the advantages and limitations of various types of sheet metal used in the trade including non-metallic materials such as plastics.
- know, and be able to apply their knowledge of the installation, and service of HVAC systems in accordance with local, provincial and national standards for the industry.
- co-ordinate sheet metal work with other trades on the job site.
- do all sheet metal related tasks expected of a journeyman.

Apprenticeship and Industry Training Committee Structure

While government supports Alberta's apprenticeship and industry training system, it is driven by industry, a term which includes both employers and employees. The Alberta Apprenticeship and Industry Training Board, with the support of Alberta Learning, oversees the system. But the system relies on a network of industry committees. These committees include local and provincial apprenticeship committees (LACs and PACs) in the designated trades and occupational committees in the designated occupations, as well as other committees such as provisional committees established before the designation of a new trade or occupation comes into effect. All these committees are composed of equal numbers of employers and employees. The network of industry committees is the foundation of Alberta's apprenticeship and industry training system.

Local Apprenticeship Committees (LAC)

Wherever there is activity in a trade, the Board can set up a LAC. The Board appoints equal numbers of employees and employers for terms of up to three years. The committee appoints a member as presiding officer. Local Apprenticeship Committees:

- monitor the apprenticeship system, and the progress of apprentices in their trade, at the local level.
- help settle certain kinds of issues between apprentices and their employers.
- recommend improvements in apprenticeship training and certification to their trade's provincial apprenticeship committee.
- make recommendations to the Board regarding the appointment of members to their trade's PAC.

Provincial Apprenticeship Committees (PAC)

The Board establishes a PAC for each trade and, based on PAC recommendations, appoints a presiding officer and equal numbers of employees and employers for terms of up to three years. Most PACs have nine members. Provincial Apprenticeship Committees:

- identify the training needs and content for their trade.
- recommend to the Board the standards for training and certification for their trade.
- monitor the activities of local apprenticeship committees in their trade.
- make recommendations to the Board about the designation of trades and occupations.
- determine whether training of various kinds is equivalent to training provided in an apprenticeship program in the trade.
- may participate in resolving any apprenticeship-related disputes between employers and employees.

Sheet Metal Worker PAC Members

Mr. J. Strause	Edmonton	Presiding Officer
Mr. R. Gertz	Calgary	Employer
Mr. C. Rowein	Edmonton	Employer
Mr. D. Connell	Fort McMurray	Employer
Mr. G. Provencher	Grande Prairie	Employer
Mr. P. Wyatt	Calgary	Employee
Mr. G. Reid	Edmonton	Employee
Mr. R. Stephenson	Edmonton	Employee
Mr. A. Cady	Lethbridge	Employee

The Alberta Apprenticeship and Industry Training Board (Board)

The mandate of the Alberta Apprenticeship and Industry Training Board relates to the standards and requirements for training and certification in programs under the *Apprenticeship and Industry Training Act*. The Board provides advice to the Minister of Learning on the training and certification of people in designated trades and occupations and on the needs of the Alberta labour market for skilled and trained persons. The Board also makes orders and regulations respecting standards and requirements for apprenticeship programs and the training of apprentices and for training and certification in designated trades and occupations, and the criteria or requirements for granting and recognizing trade and other certificates.

The 13-member Board consists of a chairman, eight members representing trades and four members representing other industries. The trades and other industry members are equally represented by employer and employee representatives.

Safety Education

Safe working procedures and conditions, accident prevention and the preservation of health are of primary importance in apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of government, employers, employees and the public. Therefore, it is imperative that all parties become aware of circumstances that may lead to injury or harm. Safe learning experiences and environments can be created by controlling the variables and behaviours that may contribute to or cause an accident or injury.

It is generally recognized that a safe attitude contributes to an accident free environment. Everyone will benefit as a result of a healthy, safe attitude towards prevention of accidents.

A tradesperson is possibly exposed to more hazards than any other person in the work force and, therefore, should be familiar with and apply the Occupational Health and Safety Act and Regulations dealing with personal safety and the special safety rules applying to each task.

Legal and Administrative Aspects of Safety

Accident prevention and the provisions of safe working conditions are the responsibilities of an employer and employee.

Employer's Responsibilities

The employer is responsible for:

- providing and maintaining safety equipment, and protective devices and clothing.
- enforcing safe working procedures.
- providing safeguards for machinery, equipment and tools.
- observing all accident prevention regulations.
- training employees in the safe use and operation of equipment.

Employee's Responsibilities

The employee is responsible for:

- working in accordance with the safety regulations pertaining to the job environment.
- working in such a way as not to endanger themselves or fellow employees.

Workplace Health and Safety's Responsibilities:

Workplace Health and Safety (Alberta Human Resources and Employment) will conduct periodic inspections of the workplace to ensure that safety regulations for industry are being observed.

Technical Training Establishment

Alberta Learning, Apprenticeship and Industry Training offer your apprenticeship training program. Staff and facilities for delivering the program are supplied by:

- Northern Alberta Institute of Technology
- Southern Alberta Institute of Technology

Procedures For Recommending
Revisions To The Course Outline

Apprenticeship and Industry Training, Industry Programs and Standards has prepared this course outline in partnership with the Sheet Metal Worker Provincial Apprenticeship Committee.

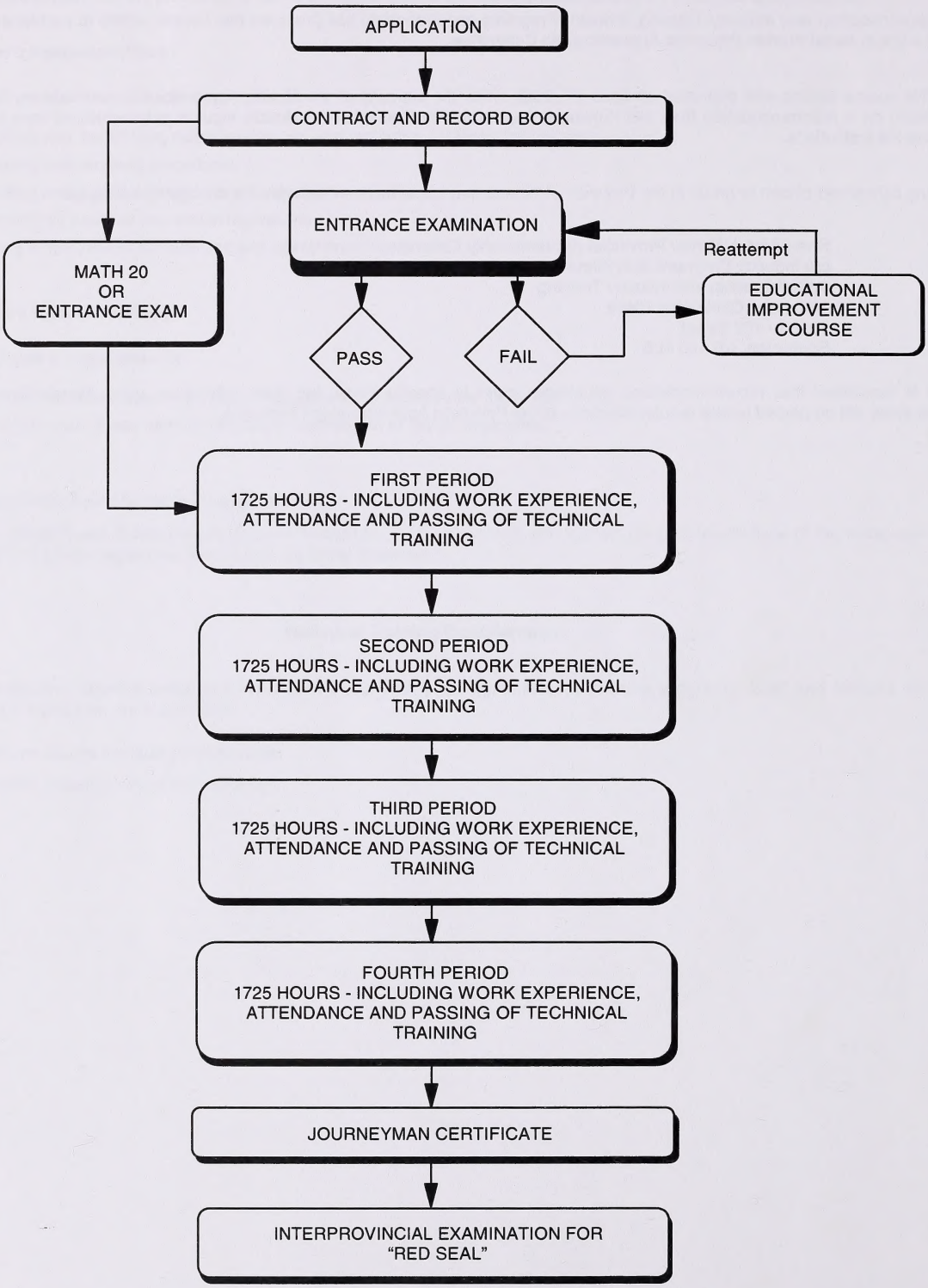
This course outline was approved on June 27, 2003 under the authority of the Alberta Apprenticeship and Industry Training Board on a recommendation from the Provincial Apprenticeship Committee. Valuable input is acknowledged from industry and the institutions.

Any concerned citizen or group in the Province of Alberta may make recommendations for change by writing to:

Sheet Metal Worker Provincial Apprenticeship Committee
c/o Industry Programs and Standards
Apprenticeship and Industry Training
10th floor, Commerce Place
10155 - 102 Street
Edmonton, AB T5J 4L5

It is requested that recommendations for change refer to specific areas and state references used. Recommendations received will be placed before regular meetings of the Provincial Apprenticeship Committee.

Apprenticeship Route Toward Certification



Sheet Metal Worker Training Profile

FIRST PERIOD

(10 Weeks 30 Hours Per Week – Total of 300 Hours)

SECTION ONE

TRADE THEORY — **40 Hours**

- **A** — Safety and Safety Regulations — 3 Hours
- **B** — Metal Working Processes — 2 Hours
- **C** — Materials, Sealants and Fasteners — 5 Hours
- **D** — Welding — 1 Hour
- **E** — HVAC Systems and Equipment — 19 Hours
- **F** — Mathematics — 10 Hours

SECTION TWO

PRACTICAL APPLICATIONS — **150 Hours**

- **A** — Tools and Metal Working Processes — 5 Hours
- **B** — HVAC Duct fittings — 80 Hours
- **C** — General Fabrication — 35 Hours
- **D** — Welding — 30 Hours

SECTION THREE

BLUEPRINT READING AND PATTERN DEVELOPMENT — **110 Hours**

- **A** — Blueprint Reading — 40 Hours
- **B** — Sheet Metal Drafting and Pattern Development — 70 Hours

SECOND PERIOD

(10 Weeks 30 Hours Per Week – Total of 300 Hours)

SECTION ONE

TRADE THEORY — **30 Hours**

- **A** — Rigging — 2 Hours
- **B** — Roofing — 2 Hours
- **C** — HVAC Systems and Equipment — 24 Hours
- **D** — Alternative to Calculation and Mathematics — 2 Hours

SECTION TWO

SYSTEMS CONTROL LAB — **30 Hours**

- **A** — Electrical Controls — 10 Hours
- **B** — Service and Maintenance — 20 Hours

SECTION THREE

PRACTICAL APPLICATIONS — **150 Hours**

- **A** — Tools and Equipment — 1 Hour
- **B** — Fabrication — 124 Hours
- **C** — Welding — 25 Hours

SECTION FOUR

BLUEPRINT READING AND PATTERN DEVELOPMENT — **90 Hours**

- **A** — Blueprint Reading — 30 Hours
- **B** — Pattern Development and Layout — 60 Hours

THIRD PERIOD
(10 Weeks 30 Hours Per Week – Total of 300 Hours)

SECTION ONE		A	B	C
TRADE THEORY 40 Hours	⇨	Residential HVAC Systems 24 Hours	Advanced Air Movement 10 Hours	Regulations 2 Hours
		D	E	
		TIG Welding (GTAW) 2 Hours	Stainless Steel 2 Hours	
SECTION TWO		A	B	C
SYSTEMS CONTROL LAB 40 Hours	⇨	Furnaces 2 Hours	Advanced Controls 19 Hours	Refrigeration 5 Hours
		D	E	
		Appliance Testing and Troubleshooting 10 Hours	Gas Fitting 4 Hours	
SECTION THREE		A	B	C
PRACTICAL APPLICATIONS 140 Hours	⇨	Commercial Duct System 50 Hours	General Fabrication 60 Hours	Welding 30 Hours
SECTION FOUR		A	B	
BLUEPRINT READING AND PATTERN DEVELOPMENT 80 Hours	⇨	Blueprint Reading 30 Hours	Pattern Development and Layout 50 Hours	

FOURTH PERIOD
(10 Weeks 30 Hours Per Week – Total of 240 Hours)

SECTION ONE		A	B	C
TRADE THEORY 35 Hours	⇨	Natural and Mechanical Air Movement 4 Hours	HVAC Systems 19 Hours	Workplace Coaching Skills 5 Hours
		D		
		Personal Computers 7 Hours		
SECTION TWO		A	B	
SYSTEMS CONTROL LAB 35 Hours	⇨	Heating and Cooling Units 20 Hours	Air Control 15 Hours	
SECTION THREE		A	B	C
PRACTICAL APPLICATIONS 150 Hours	⇨	Fabrication 120 Hours	Cladding and Lagging 5 Hours	Welding 25 Hours
SECTION FOUR		A	B	
BLUEPRINT READING AND PATTERN DEVELOPMENT 80 Hours	⇨	Blueprint Reading 40 Hours	Pattern Development and Layout 40 Hours	

NOTE: The hours stated are for guidance and should be adhered to as closely as possible. However, adjustments must be made for rate of apprentice learning, statutory holidays, registration and examinations for the training establishment and Apprenticeship and Industry Training

FIRST PERIOD TECHNICAL TRAINING
SHEET METAL WORKER TRADE
COURSE OUTLINE

SECTION ONE: ..... TRADE THEORY ..... 40 HOURS

A. Safety and Safety Regulations .....3 Hours

1. Occupational Health and Safety Act

1. Define the legal implications of the Occupational Health and Safety Act.
2. Define the obligations of employers and workers.
3. Define the authority of occupational health and safety officers.
4. Define the existence of imminent danger.
5. Explain disciplinary action.
6. Identify the Occupational Health and Safety Act General Safety Regulations as they apply to safe work practices in the Sheet Metal Worker Trade and related trades.

2. Fire prevention and control at the worksite

1. Identify the classes and applications of fire extinguishers.
2. Describe fire prevention practices at the worksite.

3. WHMIS (Workplace Hazardous Materials Information System)

1. Explain WHMIS, its rationale and major elements.
2. Define what is meant by a WHMIS label and be able to distinguish between supplier and workplace labels and other means of identification.
3. Be able to explain the following WHMIS terms:
   a) a prohibited product
   b) a restricted product
   c) a controlled product
4. Explain what a Material Safety Data Sheet (MSDS) is, its purpose and limitations.
5. Define the roles and responsibilities of employers, employees, and suppliers in the education of hazardous materials.

4. First aid, toxic substances, noise and other workplace hazards

1. List first aid procedures for workplace accidents.
2. List where to obtain first aid training and certification.
3. Describe potential health hazards for:
   a) fumes
   b) skin contact with toxic substance
   c) noise
   d) vibrating tools

B. Metal Working Processes ..... 2 Hours

1. Punching, shearing and sawing

1. Describe shearing and punching.
2. List the commonly used methods of shearing, cutting or punching holes in or sheet metal.

2. Drilling, filing and grinding

1. Identify and list the different types of drill bits and hole saws commonly used in the Sheet Metal Worker trade.
2. Identify the parts of a drill bit.
3. List four methods for sizing drill bits.

3. Forming and shaping

1. Identify the considerations, including the following, for forming sheet metal with hand tools:
   a) selection of appropriate tools
   b) shrinking
   c) stretching

4. Braking sheet metal

1. Identify the considerations, including the following, for bending sheet metal in a brake or bar folder:
   a) clearances
   b) bend allowances
   c) spring back

C. Materials, Sealants and Fasteners ..... 5 Hours

1. Materials

1. Explain the difference between (metal) elements and alloys.
2. Identify the ferrous and non-ferrous metals common to the Sheet Metal Worker trade.
3. Classify ferrous and non-ferrous metals by types of coatings, alloys and finishes.
4. State the uses, advantages, disadvantages and comparative costs of materials.
5. Identify the appropriate measure for ferrous and non-ferrous metals (e.g. SWG, Browne & Sharpe).
6. Identify conventions used in metric and imperial thickness measurement for sheet metal.
7. Explain the following mechanical and physical properties of sheet metal:
   a) annealing
   b) work hardening
   c) elasticity
   d) ductility
   e) hardness
   f) tensile strength
8. Explain oxidation and galvanic action as it relates to corrosion of metals.

2. Alternate materials

1. Identify the following alternate materials:
   a) polyvinyl chloride
   b) fibreglass
   c) fibrous glass
   d) others

2. Describe the following for the alternate materials listed:
   a) methods for storing and handling
   b) tools, equipment and machines
   c) fabricating procedures and joining
   d) resistance to corrosion

3. Seam, edges, locks and joints

1. Identify the following commonly used HVAC edges, locks and joints and calculate the allowance for each:
   a) Pittsburgh lock
   b) button or snap lock
   c) hammer lock
   d) grooved seam
   e) common duct joints (S & D standing drives, etc.)

4. Fasteners

1. Identify the following commonly used fasteners:
   a) self drilling and self tapping screws
   b) pop rivets
   c) solid rivets
   d) bolts and nuts
   e) expansion shields
   f) anchors
   g) plugs
   h) lag screws and sleeves
   i) toggle bolts

5. Caulking and sealants

1. Describe safety procedures for the use of common caulks and sealants used by sheet metal workers.
2. Describe the various types of caulks and sealants used in low pressure ducts and weatherproofing.

D. Welding.....1 Hour

1. Welding Safety

1. List the safety hazards associated with welding.
2. Describe the colour coding and special fittings used on oxyacetylene welding/cutting equipment.
3. State the danger in welding, brazing or flame cutting of plated parts (e.g. cadmium or zinc).
4. Describe the harmful rays encountered during welding.
5. Describe safety apparel required when welding or cutting.
6. Describe the precautions to be taken while setting up oxyacetylene equipment.
7. Describe the characteristics and safe handling of the gases used for:
   a) oxyacetylene welding and cutting
   b) shielding gases (MIG, TIG, etc.)

2. Equipment

1. Describe the following types of electric welding, associated equipment and the application:
   a) spot (resistance) welding
   b) carbon arc
   c) MIG (GMAW)
   d) TIG (GTAW)
   e) arc (SMAW)

2. Describe the plasma arc cutting process.

E. HVAC Systems and Equipment ..... 19 Hours

1. Introduction to air movement

1. Describe components, including the following, of the typical low pressure (less than 1" WC) single zone all-season air conditioning system:
   a) supply and return air ducts
   b) the extended plenum system
   c) branch ducts (pipes)
   d) plenum and duct take offs
   e) diffusers - boots
   f) residential exhaust systems
   g) fresh air exchanging
   h) combustion air
   i) chimney and vent connectors
   j) cooling systems

2. Forced air heating systems

1. Identify and describe the types of forced air heating systems used in Alberta.
2. Compare heating values for heating fuels used in Northern and Western Canada.
3. Discuss the advantages and disadvantages of commonly used heating fuels in terms of cost, availability, and installation requirements (e.g. furnaces, venting, clearances, etc.).

3. Gas furnaces

1. Describe the characteristics of high, mid and low efficiency furnaces.
2. Describe installation considerations such as clearances for furnaces.

4. Gas fireplaces

1. Describe gas fireplaces.
2. Describe installation considerations such as clearances for gas fireplaces.
3. Describe gas fireplace burner types.

5. Air flow

1. Explain velocity and CFM and their relationships to low pressure duct design.

6. Residential furnace installation standards

1. Describe residential heating code installation standards for low pressure plenums, ducts, and vents and their components:
   a) sizing considerations for supply and return air ducts
   b) clearances from combustible materials
   c) choice of metal and gauge
   d) location of tees or take offs
   e) registers and grilles

7. Duct insulation

1. Describe two purposes of duct insulation.
2. List the commonly used materials and procedures for insulating duct work.

8. Fire separation devices

1. Describe the proper placement and installation procedures for fire dampers and ceiling fire stop-flaps.

F. Mathematics ..... 10 Hours

1. Sheet Metal Worker Trade Mathematics

1. Solve problems involving whole numbers, fractions and decimals using:
   a) addition
   b) subtraction
   c) multiplication
   d) division
2. Perform the following operations:
   a) rounding
   b) converting common fractions
   c) use a decimal equivalent table
   d) solve problems involving percentages and ratios.
3. Solve cost and wage problems.
4. Calculate perimeters and areas of:
   a) squares
   b) rectangles
   c) circles
   d) parallelograms
5. Calculate volumes for the following containers:
   a) square
   b) rectangular
   c) cylindrical
6. Convert the following:
   a) metric and imperial (length, volume, weight, temperature, etc.)
   b) feet to inches and vice versa
   c) square inches to square feet and vice versa
   d) square inches to cubic feet and vice versa
   e) cubic measuremes to gallons
   f) gallons to imperial gallons
7. Add, subtract, divide and multiply linear measurements in the following applications:
   a) scale drawings
   b) ratios and proportions
8. Measure angles between 0 and 360 degrees with a protractor.
9. Measure thickness with a micrometer.
10. Perform the following operations in the Metric system:
    a) linear measurement
    b) calculate areas
    c) calculate volumes
    d) determine weights

SECTION TWO: ..... PRACTICAL APPLICATIONS ..... 150 HOURS

A. Tools and Metal Working Processes.....5 Hours

1. Hand tools

1. Identify sheet metal hand tools for:
   a) measurements, layout and marking
   b) cutting and notching (shearing)
   c) forming, bending and shaping
   d) fastening
   e) material removal by filing or sanding or grinding
2. Select and maintain hand tools.

2. Portable power tools

1. Identify commonly used portable power tools.

3. Explosive actuated tools

1. List safety precautions.
2. Determine proper accessories, fasteners and loads.

4. Bench machines

1. Identify commonly used sheet metal bench tools.

5. Floor machines

1. Identify commonly used sheet metal floor machines.

6. Rotary machines

1. Identify commonly used sheet metal rotary machines.

7. Powered equipment and machinery

1. Identify commonly used sheet metal powered floor equipment.

8. Stakes

1. Identify and state the purpose for commonly used stakes and various stakeholders.
2. Select and use sheet metal stakes for creasing forming and folding sheet metal.

9. Select materials

1. Distinguish and select by thickness (gauge) ferrous and non-ferrous metals common to the Sheet Metal Worker trade:
   a) plated steel
   b) stainless steel
   c) copper and brass

10. Sealants

1. Apply sealant to waterproof a mechanical joint.

11. Seams, edges and locks

1. Fabricate and join sheet metal using the following seams, joints and locks:

a) pop riveted seam
b) spot welded lap seam
c) grooved seam
d) dovetail seam
c) hammer lock on rectangle and round
d) Pittsburgh lock using lock former and end slip by hand

B. HVAC Duct Fittings.....80 Hours

1. Duct joints, cleats and connectors

1. Fabricate and assemble joints with common shop-formed and pre-manufactured connectors using the following duct fittings:
   a) plenum take offs
   b) rectangular duct reducers
   c) regular or change duct tees or tap-in take offs c/w curved throats and heels
   d) regular or change, rectangular 90° elbows
   e) rectangular regular and change "Y" branch
   f) regular or change rectangular offsets with ogee curves
   g) sleeves (e.g. fire damper, wall sleeves)
   h) rectangular and round flex connectors
2. Install a fire damper in a ductline.

C. General Fabrication .....35 Hours

1. Roof jack

1. Fabricate a square roof jack on plate (flashing) with cap on a pitch and waterproof with sealants.

2. Mitred round and conical objects

1. Fabricate a cylindrical roof jack on plate (flashing) with cap on a pitch.
2. Fabricate the following elbows and offsets using spot welded lap seams:
   a) three piece round offset
   b) four piece round elbow
   c) describe elbow seam used for adjustable elbows

D. Welding.....30 Hours

1. General safety

1. Choose the appropriate eye protection, shielding lenses and screening devices required while cutting and welding.
2. Wear the appropriate apparel for protection from harmful rays, heat, sparks and hot items.
3. Demonstrate safe practices while welding, cutting and heating.

2. Oxyacetylene

1. Set up, adjust, operate, and shut down an oxyacetylene system.
2. Hard solder (braze) 16 ga HRS lap and butt in a flat position.

3. Use an oxyacetylene cutting torch for cutting mild steel.

3. MIG welding

1. Perform the following set-up tasks:
   a) connect and disconnect shielding gas
   b) adjust gas flow
   c) choose and install correct wire
   d) adjust feed and speed
   e) inspect wires, hoses, tips, wheels, etc. for proper operation and condition
2. Make the following welds in vertical, horizontal and flat positions using MIG (GMAW) welding:
   a) stringer beads
   b) butt and flanged butt
   c) lap
   d) corner
   e) fillet welds

4. Carbon arc welding

1. Describe the set-up for arc welding machine for carbon arc welding and the carbon arc process.

5. Resistance welding

1. Set up and operate spot welder.
2. Make spot welds to the standards required for the application.

SECTION THREE:..... BLUEPRINT READING AND PATTERN DEVELOPMENT ..... 110 HOURS

A. Blueprint Reading.....40 Hours

1. Blueprint components

1. Describe the following drawing types:
   a) orthographic
      i) plan views
      ii) elevations
   b) isometric
   c) sketch or schematic including HVAC symbols relating to the following:
      i) supply duct and branches
      ii) return duct
      iii) exhaust
      iv) take offs
      v) boots
      vi) diffusers
      vii) return and exhaust grilles
      vii) vents, vent connectors and chimneys
2. Locate and identify:
   a) title blocks
   b) orientation
   c) scale
   d) cutting planes
   e) sectional views
   f) detail views
   g) construction and material symbols

2. Residential blueprint reading

1. List and describe component drawings and specifications of residential blueprints.

3. Residential heating plan

1. Compile a complete list of all the HVAC components and the supplied specifications from a residential blueprint.
2. Using a heating plan, find the location of all components of an HVAC system in a residence.

B. Sheet Metal Drafting and Pattern Development ..... 70 Hours

1. Drafting

1. Identify and use the following drafting instruments:
   a) T square
   b) set squares
   c) compasses
   d) drafting pencils
2. Complete the following simple sketches of HVAC fittings:
   a) oblique/isometric
   b) orthographic
3. Understand pattern development language.
4. Define and assign to applications, the following terms used in pattern development:
   a) pattern, layout, half pattern
   b) simple layout
   c) parallel line
   d) radial line
   e) rollation
   f) half plan
   g) stretch out
   h) step-off
   i) semi-circle
   j) primes
   k) mitre
   l) cheek
   m) heel, throat
   n) true length
   o) right triangle

2. Practical geometry

1. Bisect lines, arcs and angles with dividers.
2. Construct a perpendicular from a line or drop a perpendicular from a point above a line with dividers.
3. Construct parallel lines with dividers or rule, squares, and straight edge.
4. Divide a line or a circle into a given number of parts with dividers.
5. Construct and transfer angles with dividers.
6. Draw an oval or approximate ellipse, a true ellipse, an oblong, and polygons with drafting instruments.

3. Simple layout

1. Develop the following patterns using the simple layout method:
   a) Square or rectangular duct elbows at 45°, 60° and 90° regular and change with radius throats and heels.
   b) Duct tee or tap-in take off, flat cheeks with curved throats and heels.
   c) Regular and change duct "Y" branch.
   d) Regular and change duct offset, ogee curved.

4. Parallel line development

1. Develop patterns of the following objects using parallel line development:
   a) square and round roof jacks on a slope with plate and rain cap
   b) 3 piece round offset
   c) 4 piece round elbow
   d) four-sided vase

5. Radial line development

1. Develop patterns for the following conical projects using radial line development:
   a) right conical rain cap
   b) conical rain cap
   c) conical roof jack (flat roof)
2. Determine conical cap cut-outs for a given diameter and slope.

SECOND PERIOD TECHNICAL TRAINING
SHEET METAL WORKER TRADE
COURSE OUTLINE

SECTION ONE: ..... TRADE THEORY ..... 30 HOURS

A. Rigging ..... 2 Hours

1. Describe safe rigging and hoisting practices, as applied to sheet metal work, with emphasis on:
   a) fibre rope and knots
   b) wire ropes, slings, hooks and fittings
   c) blocks, block and tackles, come-alongs and chain falls
2. Distinguish between safe and unsafe rigging procedures.
3. Identify, describe and use crane and hoist signals.

B. Roofing ..... 2 Hours

1. Terms

1. Define the following roofing terms:
   a) slope
   b) rise
   c) run
   d) span

2. Seams

1. Identify the following roofing seams by cross section sketch, describe the seam's characteristics for weatherproofing, expansion and contraction, and methods of fabrication:
   a) flat seam
   b) standing seam
   c) batten seam
   d) corrugated

3. Materials

1. List advantages and disadvantages of the commonly used roofing materials related to:
   a) expansion and contraction
   b) resistance to corrosion

4. Cutting Practices

1. Describe restrictions and precautions pertaining to cutting holes in roofs

5. Flashings

1. Identify and describe the purpose of the following types of roof flashings and accessories:
   a) base flashing
   b) counter flashing
   c) coping
   d) drip cap

6. Curbs and roof jacks

1. Describe the procedures for placing curbs and roof jacks and gum cups.

2. Describe the considerations and procedures for penetrating and sealing curbs and roof jacks in existing roofs, including shingled, BUR, and metal clad roof types.

C. HVAC Systems and Equipment .....24 Hours

1. Principles of combustion, heat and temperature

1. Describe how combustion results in heat energy.
2. Describe the meaning of heat in terms of molecular movement.
3. Describe specific heat.
4. Describe temperature measurement and systems of measurement.
5. Describe how the values for BTUs, Kilowatts, and Joules are determined.

2. Warm air heating and air conditioning

1. Define the following heating terms:
   a) conduction
   b) convection
   c) radiation
   d) latent heat (of evaporation)
2. Describe the effects of expansion caused by heat on ductwork, joints, hangers and supports.

3. Relative humidity

1. Define relative humidity.
2. Describe the effect of relative humidity and temperature on personal comfort and health.
3. Describe the effect of relative humidity on structures.
4. List methods for increasing or decreasing relative humidity.
5. Define the following terms:
   a) saturated air
   b) dew point
   c) wet and dry bulb temperatures
6. Determine relative humidity with a sling psychrometer and psychrometric chart.

4. Fresh air

1. Describe the fresh air requirement for new construction (residential).
2. Describe, including the following, residential air make up systems:
   a) pre heat
   b) the operation of heat recovery ventilation units

5. Residential and commercial venting

1. Use code tables to determine the following when venting a gas appliance:
   a) size and types of vent connectors
   b) methods of venting
   c) direct vent
   d) venting considerations for high efficiency (no chimney) appliances
   e) draft hoods, barometric draft controls and dampers
2. Explain the cause of "back draft" in a vent and its prevention.
3. Describe venting procedures for “direct vent” fireplaces and appliances.
4. Describe how combustion air for B vent and Direct vent fireplaces is obtained.

5. Calculate the amount of air required for gas appliance installations for:
   a) combustion
   b) ventilation and draft hood dilution

6. Be able to interpret and reference the codes applicable to heating, ventilating and air conditioning, including the:
   a) Alberta Building Code
   b) National Fire Code
   c) Canadian Gas Association B 149-1

D. Alternatives to Calculation and Mathematics .....2 Hours

1. Framing square

1. Use a framing square to:
   a) calculate equivalent pipe diameters
   b) lay out a rectangle or square to round
   c) construct a 30° - 60° right triangle
   d) find the centre of a circle
   e) reproduce the slope or pitch of a roof
   f) transfer angles

2. Three, Four and Five Rule

1. Describe how the 3,4,5 Rule can be used to find a right angle.

2. Describe how a tape or rule is used to determine whether a rectangle or square area has 90 degree corners.

3. Circumference rule

1. Determine stretch outs, area and diameter, when the circumference is known.

SECTION TWO: ..... SYSTEMS CONTROLS LAB ..... 30 HOURS

A. Electrical Controls .....10 Hours

1. Basic electricity

1. Explain electrical circuits in terms of electron flow.

2. Define the following basic terminology, symbols and circuits:
   a) volts
   b) ohms
   c) amps
   d) watts
   e) parallel and series circuits

3. Describe household AC wiring conventions, including:
   a) ground wires
   b) differentiate “neutral” and “hot” wires
   c) circuit breakers
   d) switches
   e) “splitting” 220 volts

4. Describe line voltage wiring for furnaces, exhaust fans, and other applications.

5. Identify the common electrical symbols found in HVAC control schematics.

6. Define the limits of the sheet metal worker regarding the wiring of HVAC equipment

2. Control systems and devices

1. Apply the following basic electrical theory to analysis of furnace controls:
   a) circuits (series and parallel)
   b) electromagnetism
   c) current
   d) symbols
   e) Ohm's Law
2. Describe commonly used burner types.
3. Describe the proper procedure for lighting pilot burners.
4. Describe conventional heat exchanger design and flue pipe travel.
5. Describe the functions of the following items used in gas appliance control systems:
   a) thermostat (conventional and programmable)
   b) thermocouples and thermopiles
   c) transformers
   d) gas valves
   e) limit switches and other safety devices
6. Describe "fail-safe" control circuitry.

3. Gas fireplace

1. Describe the controls of a gas fireplace.

B. Service and Maintenance.....20 Hours

1. Furnace servicing

1. Perform start up and verify proper operation for a typical new furnace installation.
2. Program a thermostat for night and day operation.

2. Furnace maintenance

1. Describe the following annual maintenance requirements for furnaces:
   a) fans and motor
   b) replace bushings and bearings in the blower
   c) align and adjust belts and drives
   d) adjust motor rotation
   e) proper isolation of blowers

3. Accessory Maintenance

1. Describe annual maintenance requirements the following:
   a) heating accessories:
   b) humidifiers
      i) drum humidifiers
      ii) spray humidifiers
      iii) flow-thru humidifiers
      iv) steam humidifiers
   c) replace bushings and bearings in the blower

4. Filters

1. Describe the various types of filters, applications, maintenance requirements, and the relationship to indoor air quality.

5. Troubleshooting

1. Troubleshoot common vent or other safety interlock problems that can interfere with furnace start up.

SECTION THREE:..... PRACTICAL APPLICATIONS ..... 150 HOURS

A. Tools and Equipment .....1 Hour

1. Power shear and brake

1. Set up and operate a power shear.
2. Set up and operate a power brake.

B. Fabrication .....124 Hours

1. Ductline

1. Fabricate the following:
   a) rectangular transition elbows, flat back and on-centre 90°
   b) rectangular transitional “Y” branch
   c) transitional rectangular "Y" branches off mains
   d) transitional rectangular offsets with ogee curves

2. General practical projects

1. Fabricate the following:
   a) flat back and island canopy
   b) 16 ga. canopy with concave or convex curves and welded seams
   c) round pipe tee, 45 and 90 degree on and off centre, equal or different diameters
2. Fabricate three piece square or rectangular pans including the following operations:
   a) double seam
   b) single hem to inside
   c) wired edge
3. Fabricate a cylindrical object with:
   a) double seam bottom
   b) wired edge
   c) soldered
   d) inside lid
4. Fabricate a funnel with wired edge.
5. Fabricate a pail with solid riveted bail ears.
6. Fabricate a rectangle to round.

C. Welding .....25 Hours

1. SMAW (arc electrode)

1. Set up and operate SMAW equipment safely.
2. Choose the appropriate or specified electrode.
3. Complete the following welds using SMAW:
   a) weave beads
   b) lap
   c) butt
   d) edge
   e) corner
   f) horizontal
   g) flat

4. Weld a simple project using 16 gauge material.

2. Soldering

1. Select and identify soldering coppers by:
   a) shape
   b) size
   c) application
2. Describe explosion, fire and safety precautions associated with soldering.
3. Describe the purpose of a flux.
4. Describe the difference between hard and soft soldering.

SECTION FOUR: ..... BLUEPRINT READING AND PATTERN DEVELOPMENT ..... 90 HOURS

A. Blueprint Reading ..... 30 HOURS

1. Residential and commercial blueprints

1. Read and interpret residential multiple story, multiple family, and light commercial blueprints.
2. Identify and locate all HVAC components including supply, return and exhaust duct lines.
3. Make a materials list, including the completed duct and fittings required for installation.

B. Pattern Development and Layout ..... 60 Hours

1. Parallel line

1. Use parallel line development to develop the following patterns:
   a) leader head with concave or convex curves
   b) pipe tees, on and off centre, 45 and 90 degrees, equal and unequal diameters
   c) rectangular roof jack on a slope, with or without a rain cap
   d) 45° rectangular duct tee on round pipe, on and off centre

2. Triangulation

1. Use triangulation to develop the following patterns:
   a) rectangular duct transition - on centre - flat one side - flat two sides
   b) rectangular or unequal square duct transition 1/4 twist-on centre
   c) rectangular 90° transition elbow - flat back or centre tapering
   d) transitional duct tee or hammer lock take-off-curved throat and heel
   e) rectangular "Y" branch - transitional cheeks and change branch sizes
   f) rectangular offset - ogee - regular-offset two ways
   g) square or rectangular to round - on centre - off centre one way - off centre two ways

3. Radial line

1. Use radial line to develop the following patterns:
   a) round to round taper on centre radial line and transfer of angles method

THIRD PERIOD TECHNICAL TRAINING
SHEET METAL WORKER TRADE
COURSE OUTLINE

SECTION ONE: ..... TRADE THEORY ..... 40 HOURS

A. Residential HVAC Systems ..... 24 Hours

1. Heat loss and gain

1. Describe heat loss and heat gain.
2. Describe how heat is lost through:
   a) exposed walls and partitions
   b) windows and doors
   c) ceilings and roofs
   d) floors
   e) infiltration
   f) system losses
   g) ventilation air
   h) exhaust fans
   i) ducts in unheated spaces
3. Describe how the following contribute to the heat gain of a structure:
   a) summer outside design temperature
   b) radiation from the sun
   c) heat and moisture given off by equipment, appliances and people
   d) heat and moisture gained by infiltration

2. Cooling

1. Explain the following terms:
   a) ton of refrigeration
   b) condensation

3. Heat loss calculation

1. Describe thermal resistance.
2. Calculate the R-value for walls, windows, doors and roofs using construction details and R-value tables.
3. Calculate heat loss and fresh air requirements (Alberta Building Code, new residential construction).
4. Calculate heating and cooling requirements using local outside design temperatures.

4. HVAC system design

1. Select correct size and type of design for heating and cooling equipment to match load calculation.
2. Design a basic residential perimeter air distribution system for heating and cooling including:
   a) duct and pipe sizes
   b) diffuser and grille sizes and location
   c) thermostat location
   d) noise attenuation
   e) insulation
   f) flexible connectors
   g) vibration mounts
   h) humidification and filtration
   i) calculate (building code) fresh air requirements for new construction
   j) devices and controls used to ensure adequate ventilation air building code requirements

5. Ventilation air requirements

1. Describe ventilation air requirements in the Alberta Building Code (section 9.32) for new construction.
2. Describe the relationship between the Alberta Building Code ventilation requirements and the CSA F326 standard.

6. Air flow

1. Describe continuous air circulation and the proper adjustment necessary for cooling.
2. Describe the procedures for balancing a residential air system.
3. Describe the following instruments:
   a) inclined manometer
   b) pitot tube
   c) velometer

3. Advanced Air Movement ..... 10 Hours

1. Pressure classifications

1. Describe how duct is classified according to velocity and pressure.
2. Describe the common duct sealant procedures for high velocity and low velocity systems.
3. Apply SMACNA (Sheet Metal and Air Conditioning Contractors National Association) standards for joints and connections.
4. Describe commercial mechanical duct connections and applications.

2. Pressure loss

1. Describe the following terms and the relationship to duct design:
   a) turbulence
   b) static, velocity and total pressure
   c) system resistance
   d) friction loss
   e) dynamic pressure loss
   f) velocity and CFM
   g) aspect ratio
   h) diverging and converging fittings

3. Duct design

1. Describe the SMACNA fabrication standards for ducts and their components:
   a) choice of metal and gauge
   b) corner closures
   c) support and hanger system
   d) two piece streamliners
   e) tee connections
   f) register and grille connections
2. Describe the following components of elbow design:
   a) aspect and radius ratios
   b) turning vanes
   c) splitters
3. Solve problems of duct design with a friction chart and ductulators.

C. Regulations ..... 2 Hours

1. Codes and regulations

1. Identify the following codes and regulations:
   a) Alberta Building Code (ABC)
   b) Canadian Gas Association (CGA - B 149-1-2)
   c) Canadian Standards Association (CSA)
   d) Underwriters' Laboratories of Canada (ULC)
   e) National Fire Protection Association (NFPA)
   f) Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
2. Apply codes to the following applications:
   a) heating and air conditioning systems
   b) natural and mechanical ventilation
   c) residential and commercial fabrication and installations
   d) gas and oil burning appliances

2. Fire and smoke containment

1. Describe how HVAC systems may be required to contain fire and smoke.
2. Describe how fire separation and containment is incorporated in building HVAC system design or code requirements.

D. TIG welding (GTAW) ..... 2 Hours

1. Safety

1. List the safety precautions for TIG welding.

2. Equipment set-up, and materials

1. Describe setting up and operating the equipment.
2. Identify the non-consumable electrodes commonly used for sheet metal TIG welding.
3. List the shielding gas mixtures used for sheet metal welding.
4. Describe the application of each gas type for commonly used sheet metal alloys.
5. Describe the set-up requirements, including gas selection, electrode preparation and machine settings, for welding mild steel, aluminum and stainless steel.

E. Stainless Steel ..... 2 Hours

1. Stainless steel identification

1. Distinguish stainless steel in the austenitic group.
2. Describe the main alloys of stainless steel and list their applications.
3. Identify various factory finishes available in sheet form.

2. Cutting forming and joining stainless steel

1. Describe the restrictions and capacities of equipment used for performing the following procedures on stainless steel:
   a) cutting
   b) forming

c) drilling
d) punching

2. Identify tools and fastening devices for stainless steel.

3. Describe the methods of grinding, sanding, polishing and buffing.

4. Describe welding and soldering techniques.

SECTION TWO: ..... SYSTEMS CONTROLS LAB ..... 40 HOURS

A. Furnaces ..... 2 Hours

1. Liquid fuelled, solid fuelled and electrical furnaces

1. Identify the basic components that make up the control systems on oil, solid fuel and electric furnaces.

B. Advanced Controls ..... 19 Hours

1. Controls

1. Identify and describe the operation of electronic controls.

2. Describe the various ignition systems used on mid and high efficiency gas appliances.

2. Installing and servicing controls for heating cooling and ventilation

1. Describe control systems for cooling makeup air, air quality, and ventilation.

2. Interpret electrical schematics used in furnace control systems.

3. Wire a control circuit using contemporary furnace controls, and include the following:
   a) ignition modules
   b) control modules
   c) forced draft systems
   d) automatic (vent) dampers
   e) new control technology

C. Refrigeration ..... 5 Hours

1. Small (less than 5 ton) air conditioning systems

1. Describe a basic air conditioning system, including:
   a) compressor
   b) evaporator
   c) condenser
   d) metering
   e) line and pipe sizing

2. Describe how humidity levels can be controlled with dehumidifiers.

3. Describe the need for refrigerant recovery and recycling.

D. Appliance Testing and Troubleshooting ..... 10 Hours

1. Describe an appliance efficiency test for a gas furnace.

2. Describe annual fuel utilisation efficiency.

3. Use the following test instruments to diagnose control circuits and burners:
   a) millivolt and volt meter
   b) CO_2 tester
   c) smoke gauge
   d) draft gauge
   e) multi-meters
   f) manometer
   g) amprobe
   h) stop watch
4. Verify appliance energy input by clocking gas meter.
5. Diagnose the fault in a non-functioning gas furnace.

E. Gas Fitting ..... 4 Hours

1. Use proper procedure to thread, flare and bend gas pipe.
2. Apply safety regulations and codes for gas appliances.

SECTION THREE: ..... PRACTICAL APPLICATIONS ..... 140 HOURS

A. Commercial Duct System ..... 50 Hours

1. Duct line

1. Interpret blueprints and specifications to fabricate a medium pressure duct system to SMACNA standards, incorporating the following fittings:
   a) rectangular elbows with turning vanes
   b) rectangular to round transitions
   c) boot tees and various pipe tees
   d) round tapering elbows
   e) round pipe reducers
   f) round "Y" branch
   g) round tapering offset
   h) welded joints and seams

B. General Fabrication ..... 60 Hours

1. Fabrication

1. Fabricate the following:
   a) square or rectangle to round with pitched base, 10 ga aluminum, welded seams
   b) rectangular roof ventilator (goose neck)
   c) welded stainless steel bar sink
   d) projects in 16 gauge or heavier sheet metal, incorporating
      i) welded seams
      ii) door, louvers, etc.

2. Computerised layout

1. Use a computer to make patterns for fabricating at least one of the duct line fitting projects listed above.

3. Shop calculations

1. Apply formulas, traditional and short cut methods to solve trade related mathematical problems.

2. Determine braking points on heavy gauge material for inside and outside finished dimensions.

3. Calculate circular or oval stretchout for a desired ID and OD for heavy gauge sheet metal.

C. Welding.....30 Hours

1. Make the following TIG welds in vertical, horizontal and flat positions using aluminum, stainless steel and ferrous sheet metal:
   a) stringer beads
   b) butt and flanged butt
   c) lap
   d) corner
   e) fillet welds

2. Weld a metal project using the G.M.A.W. process.

SECTION FOUR: ..... BLUEPRINT READING AND PATTERN DEVELOPMENT ..... 80 HOURS

A. Blueprint Reading.....30 Hours

1. Large commercial

1. Estimate a complete list of duct, fittings, grilles and equipment from the mechanical (HVAC) print.

2. Identify possible areas of conflict within the following sections of prints:
   a) architectural
   b) mechanical
   c) structural
   d) electrical

2. Specifications

1. State the purpose of a standard specification.

2. State the relationship of specifications to drawings.

3. Locate information from a standard specification.

3. Shop drawings

1. Produce work sheets from the mechanical (HVAC) print for the fabrication of ducts and fittings.

2. Make legible sketches for the fabrication of complex fittings (e.g. off-centre, offset transitions and square to rounds).

3. Create 3 dimensional sketches of sheet metal objects using oblique or isometric drawing techniques.

4. Residential heating schematic

1. Using a residential architectural floor plan for a single zone, single family, single story dwelling (e.g. 3 bedroom bungalow with full undeveloped basement), produce a legible heating schematic (not scaled) showing all ducts, pipes, supply, return air and exhaust and fresh air, combustion air and chimney located in relation to windows, doors, stairwells and interior walls, on an 8.5 X 11" piece of paper.

B. Pattern Development and Layout.....50 Hours

1. Parallel line

1. Produce accurate patterns for the following duct fittings using parallel line development:

a) boot tees, on and off centre
b) long radius 90° elbow made in 5 pieces
c) various shaped hoppers and hoods and boots as used in dust collection systems.

2. Triangulation

1. Produce patterns for the following duct fittings using triangulation:
   a) square or rectangle to round - pitched base
   b) rectangle to round – offset two ways
   c) garbage chute head
   d) piece, 90° tapering round elbow - centre taper
   e) piece tapering round offset - centre taper
   f) round pipe reducers, in line or flat one side
   g) round "Y" branches
   h) rectangular 2 way transitions

3. Radial line

1. Produce patterns for right conical objects using radial line development:
   a) conical pipe tees
   b) round pipe tee on right cone
   c) roof jack on pitch
   d) tapering elbow
   e) horizontal round pipe tee on right cones
   f) vertical round pipe tee on right cone
   g) right conical 90° tee on round pipe
   h) right conical angle tee on round pipe

FOURTH PERIOD TECHNICAL TRAINING
SHEET METAL WORKER TRADE
COURSE OUTLINE

SECTION ONE: ..... TRADE THEORY ..... 35 HOURS

A. Natural and Mechanical Air Movement ..... 4 Hours

1. Natural ventilation

1. Define the need for ventilation.
2. List common applications of natural ventilation.
3. Describe and explain how wind and thermal forces work.
4. Describe the following terms:
   a) windward
   b) leeward
   c) stack action
5. Describe how thermal forces work.
6. Define air stratification.
7. List the various types of openings, normal locations and their effect on air movement.
8. Describe ventilation requirements for attics and crawl spaces.

2. Mechanical air movement

1. Identify the following basic classifications of fans and their intermediate forms:
   a) centrifugal
      i) forward curved
      ii) backward inclined
      iii) radial or straight
      iv) axial flow
   b) propeller or disc
      i) tube axial
      ii) vane axial
2. Explain how to use blower performance graphs with reference to:
   a) static pressure curve
   b) horsepower curve
   c) CFM and RPM

3. Controlling air flow for volume

1. Describe the purpose and functions of:
   a) splitters
   b) air extractors
   c) volume dampers
   d) single blade
   e) multiple blade
   f) opposed and parallel blade
   g) slide
   h) back draft or relief

B. HVAC Systems ..... 19 Hours

1. Heating and cooling systems

1. Describe the following basic types of heating and cooling systems:
   a) low pressure
      single zone
      reheat
      multizone
   b) high pressure
      reheat
      dual duct
      induction
      multizone
2. Describe variable air volume (VAV) systems and explain how they differ from constant volume systems.
3. Identify the following terminal units associated with heating and cooling systems and describe their operation:
   a) reheat
   b) mixing box
   c) attenuator
   d) induction terminal unit
   e) VAV terminals

2. Industrial exhaust

1 Describe exhaust systems used in the removal of industrial contaminants.

2. List the recommended fabrication and installation practices for fume and dust removal systems regarding:
   a) taper angles
   b) sizing
   c) throat radius of elbows
   d) type and gauge of material
   e) dampers
   f) hoods and collectors

3. Sound control

1. Describe the following methods for reducing noise and vibration at the fan and motor:
   a) isolation mounts
   b) flexible connectors
   c) silencers
2. Describe how noise reduction can be obtained in an air conditioning duct system by using:
   a) acoustical lining
   b) K-duct
   c) fibrous glass duct
   d) attenuators or sound traps

4. Air cleaning

1. Identify undesirable contaminants which can be minimised or controlled.
2. List methods of measuring concentrations of dust.
3. Describe the following methods used to clean air:
   a) screening or filtering
   b) electrostatic precipitators
   c) electronic air cleaner
   d) washing
4. Describe correct methods for installing air washers and filters.

5. Commercial kitchen exhaust systems

1. Identify regulations from the Alberta Building Code and NFPA - 96 as they apply to the installation of equipment for the removal of smoke and grease-laden vapours from commercial kitchens.
2. Select the correct type of kitchen exhaust hood to match equipment.
3. Correctly size a canopy to match equipment layouts.
4. Describe the minimum requirements for fabricating and installing grease removal duct systems.
5. Describe grease removal devices used in kitchen exhaust systems.
6. Calculate make-up air requirements for an exhaust system.

6. High efficiency systems

1. Describe R2000 and related standards for high effiency and reduced heat loss.
2. Describe how construction affects ventilation and air circulation.
3. Describe the HVAC considerations for retrofitting older buildings with upgraded insulation and or air leakage upgrading.

7. Regulations and standards

1. Use and Interpret:
   a) Alberta Building Code
   b) CGA - B 149-1-2
   c) CSA
   e) ULC
   f) NFPA
   g) SMACNA
2. Identify revisions and updates to the above codes and regulations from:
   a) standata
   b) new publications
   c) local authorities
3. Describe how building and installation codes can vary within the province.
4. Describe how the Alberta Building Code relates to municipal, national, and international codes and standards.
5. Describe the responsibilities regarding codes and standards while working in other jurisdictions.
6. Interpret codes and regulations for the following:
   a) solid fuel burning appliances
   b) flue and chimney installation
7. Describe international standards for manufacturers and installers.
8. Describe the ISO certification process.
9. Describe alternate energy.
10. Define solar energy and list the major components of a solar heating system.
11. Describe active and passive solar systems.
12. Describe solid fuel systems.
13. Describe geothermal heating systems.

C. Workplace Coaching Skills ..... 5 Hours

1. Describe the following coaching skills used in training apprentices:
   a) identify the point of the lesson
   b) link the lesson
   c) demonstrate a skill
   d) provide opportunity to practice a skill
   e) give feedback to the learner
   f) assess the learner's progress

D. Personal Computers ..... 7 Hours

1. Describe common sheet metal applications for personal computers.
2. Describe a spreadsheet for an HVAC or business related problem, such as:
   a) time and wages calculation
   b) materials and cost calculation
   c) application of a formula such as a bend allowance or determining a circumference stretchout with allowances

SECTION TWO: ..... SYSTEMS CONTROLS LAB ..... 35 HOURS

A. Heating and Cooling Units ..... 20 Hours

1. Equipment

1. Describe the function and operation of the following equipment:
   a) dual systems (combined heating cooling)
   b) make-up air
   c) heat pumps
   d) single and multi-fuel systems
   e) wood burning appliances
   f) HRV units

2. Metering, wiring and troubleshooting

1. Use multimeters to measure volts, ohms, and amps.
2. Start up, monitor the sequence of operation, and shut down residential and commercial equipment and appliances.
3. Take RPM readings on fan blowers and motors using:
   a) revolution counter
   b) strobotac
4. Check and record temperatures in vents, units, plenums and duct systems.
5. Check for concentration of carbon monoxide.
6. Use wiring diagrams to trace the following circuits and components:
   a) two and multi-speed motors
   b) refrigeration circuits
   c) heat-cool, make-up air, mid and high efficiency units

3. Refrigeration

1. For systems to 60,000 BTUH (5 ton):
   a) recharge refrigerant.
   b) recover refrigerant to auxiliary container.
   c) perform pump down to remove moisture.
   d) find and repair refrigerant leaks.
   e) perform system purge.
   f) recycle refrigerant.

B. Air Control ..... 15 Hours

1. Measurement of air flow and pressure

1. Identify and describe the application and operation of the following instruments used in air balancing:
   a) velometer
   b) anemometer
   c) pitot tube

2. Balancing

1. Describe the procedures and methods used in balancing HVAC systems.
2. Balance a single zone multi outlet HVAC system.

SECTION THREE: ..... PRACTICAL APPLICATIONS ..... 150 HOURS

A. Fabrication ..... 120 Hours

1. General projects

1. Fabricate one of the following or any chosen project that is appropriate as a final period project demonstrating the skills of a completed apprentice:
   a) stationary louver
   b) Island canopy
   c) multiblade volume damper
2. Fabricate component parts of fume and dust removal systems such as:
   a) tanks
   b) bins
   c) hoppers
   d) collectors
   e) sander hoods
   f) floor sweeps
   g) acid tanks with slotted side exhaust.
3. Fabricate a low profile gravity roof ventilator.
4. Fabricate equipment plenums or equipment casings with 1 inch duct liner and expanded metal, including an access doors in addition to the inlet and outlet.
5. Fabricate an irregular-shaped elbow.

2. Optional individual projects

1. Fabricate four of the following:
   a) coal scuttle
   b) tapered measuring jug with spout and handle
   c) custom funnel (rectangular to square)

d) oblong to round
e) two way offset
f) rectangular to rectangular transition, equal taper
g) Y branch with square and round branches
h) Y branch with more than two branches
i) copper mug
i) stacking tray
k) ventilator
l) cladding and lagging a vessel with domed ends

3. Final project

1. Fabricate a project that incorporates one of the following:
   a) rectangular to round duct, branches, changes and transitions using various joints and strengthening procedures and sealants
   b) a high degree of accuracy and finishing (e.g. stainless and steel kitchen or architectural project)

B. Cladding and Lagging .....5 Hours

1. Install metal cladding and lagging on gas plant simulations, including:
   a) pipe fittings and valves
   b) elbows
2. Apply site (field) methods for weatherproofing practices, joining and seaming.
3. Identify the materials, seams, and weatherproofing practices required for cladding and lagging pipes, fittings and vessels.
4. Use blueprints and specifications to fabricate and install sheet metal cladding and lagging.

C. Welding.....25 Hours

1. Aluminum MIG welding

1. Weld aluminum using the MIG process.

2. Stainless steel MIG welding

1. Produce finished stainless steel welds using the MIG process.

3. CNC Plasma Arc cutting table

1. Describe the operation of a CNC plasma arc cutting table.

SECTION FOUR: ..... BLUEPRINT READING AND PATTERN DEVELOPMENT ..... 80 HOURS

A. Blueprint Reading.....40 Hours

1. Industrial blueprint interpretation

1. Interpret industrial plant blueprints and include the following:
   a) plan, elevation and section views
   b) site, plot
   c) schedules
   d) equipment rooms
   e) specification of construction materials and equipment
   f) symbols
2. Correlate related trade items that influence HVAC installations from:
   a) architectural
   b) electrical
   c) other mechanical
3. Describe the scope of sheet metal work as specified by the Alberta Construction Tendering System.

2. Specifications

1. Identify material, installation and equipment specifications.
2. Determine damper, register, fan, equipment location and type.

3. Materials list and estimating

1. Using a blueprint and specifications for a small commercial or industrial job, take off all HVAC related materials and make up a materials list.
2. Describe how an estimate is completed that includes material, equipment, labour, and overhead (fixed and variable) costs.

B. Pattern Development and Layout.....40 Hours

1. Shop drawing

1. Complete a reproducible shop drawing, incorporating the following, of a simple production item that contains at least three sheet metal components that are to be cut out, folded, and assembled:
   a) necessary views and dimensions to build item
   b) a materials list
   c) cut list
   d) specifications

2. Parallel line

1. Develop patterns of the following sheet metal objects using the principles of parallel line:
   a) right and oblique cylinders
   b) gussets for elbows and teesc)
   c) finials, pedestals and segmental vases
   d) coverings for dome ends using the gore principle
   e) double projection for pipe intersection

3. Radial line

1. Develop patterns for the following conical objects using radial line development:

a) standard oblique cones
b) 3-way breaches
c) oblique conical projection for "Y" branch

4. Triangulation

1. Develop patterns for the following sheet metal items using the principles of triangulation:
   a) square and rectangle to round off centre two ways
   b) side and top take offs
   c) boots on and off centre
   d) right angle boot on and off centre
   e) bull-head tee
   f) three and four way breeches

5. Shortcuts

1. Develop patterns using rollation and "slipping" for:
   a) square to round
   b) tapers
   c) transition elbows and offsets
2. Calculate mitre in the field.
3. Calculate offset length in the field.
4. Produce patterns for the following objects using radial line development:
   a) conical pipe tees
   b) round pipe tee on right cone - long and short method
   c) horizontal round pipe tee on right cones
   d) vertical round pipe tee on right cone
   e) right conical 90° tee on round pipe
   f) right conical angle tee on round pipe

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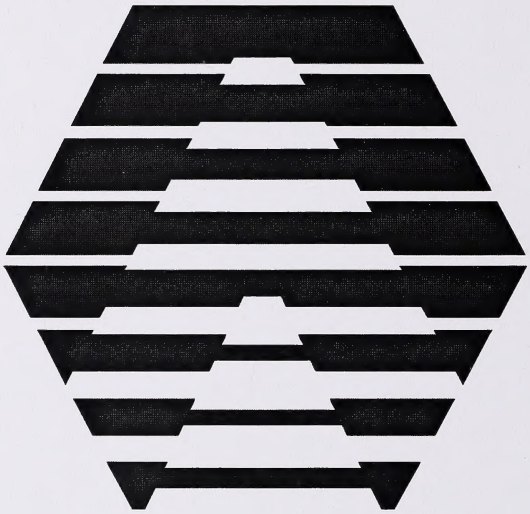

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1103